MagLifter

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Achieving an affordable and reliable launch infrastructure for low-cost, routine access to space is one of the enduring challenges of the space age. In a marketplace dominated by expendable launch vehicles grounded in the technology base of the 1950's and 1960's, diverse innovative approaches have been conceived since 1970 for reducing the cost per pound for transport to low-Earth orbit. For example, the space shuttle—a largely reusable vehicle—was developed in the 1970's with the goal of revolutionizing Earth-to-orbit transportation. Although the shuttle provides many important new capabilities, it did not significantly lower space launch costs. During the same period, a variety of other launch requirements (e.g., for vehicle research and development and microgravity experiments) have been met by relatively expensive, typically rocket-based solutions (e.g., rocket sleds and sounding rockets).

There are several basic strategies for cost reduction, including: (1) reducing the cost of hardware expended in launcher systems per pound of payload, (2) increasing the reusability per flight of highly reusable vehicles, and (3), for both of these, reducing the cost of launch operations. A variety of space launch concepts are still under study in this context, ranging from single-stage-to-orbit vehicles to "big, dumb boosters," and from air-breathing hypersonic Earth-to-orbit vehicles like the National Aerospace Plane to advanced rocket concepts such as space nuclear thermal propulsion. Some exotic concepts involving "gun-type" systems have also been studied.

However, past analyses of launch systems involving electric propulsion have been largely limited to electromagnetic versions of "cannons," such as rail guns and coil guns. Despite significant theoretical advantages, these systems have had both technical and programmatic difficulties in maturing beyond research and development and prototype-level demonstrations.

A new approach, involving the use of superconducting, magnetically levitated ("maglev") and propelled vehicles, has been developed. Three configurations of the MagLifter concept shown in figures 4–6 combine the technology base of maglev systems being proposed and demonstrated for terrestrial applications with the best planned improvements in expendable launch and highly reusable vehicle systems. Together, the results suggest dramatic improvements in Earth-to-orbit costs may be possible. The MagLifter draws on a heritage of electromagnetic launch concepts and technical literature, but embodies several new technical characteristics which have not been thoroughly considered to date.

Sponsor: Office of Space Access and Technology

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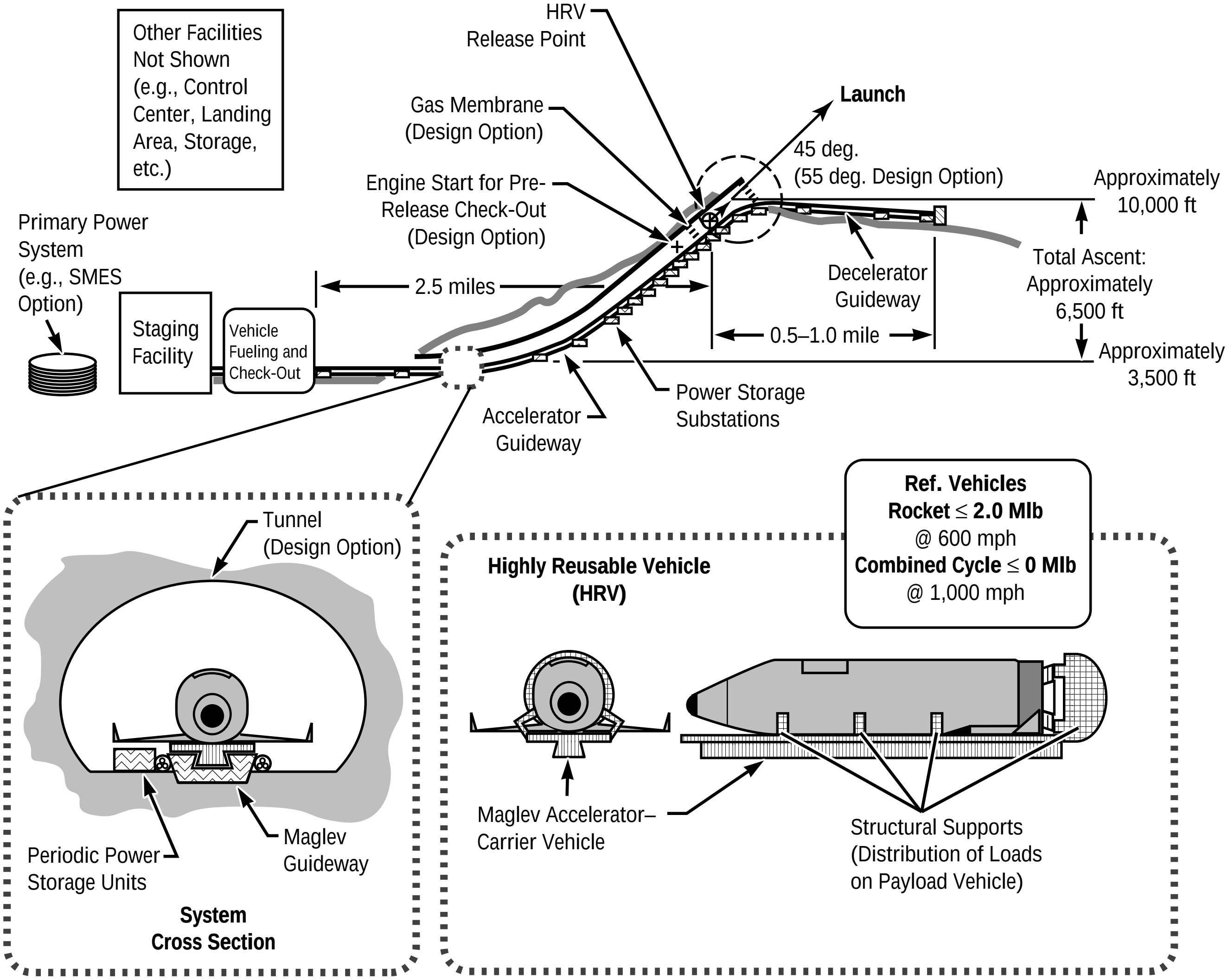

FIGURE 4.—MagLifter Space Launch System (configuration “i”); notional, full-scale system concept. This version of MagLifter is configured for a highly reusable vehicle that *does not* involve the use of aerodynamic lift during launch (i.e., a ballistic ascent trajectory).

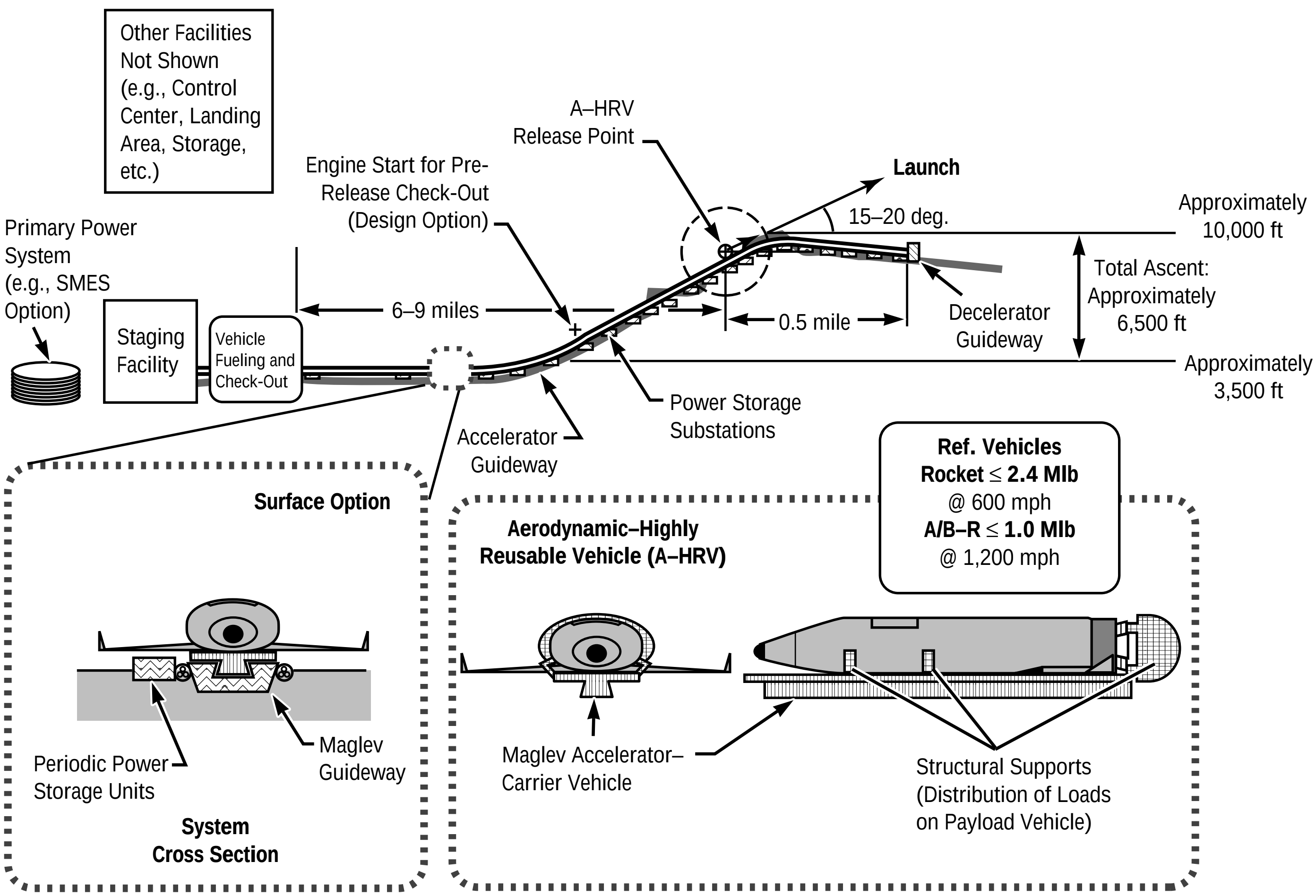

FIGURE 5.—MagLifter Space Launch System (configuration “j”); notional, full-scale system concept. This version of MagLifter is configured for a highly reusable vehicle that *does* involve the use of aerodynamic lift during launch.

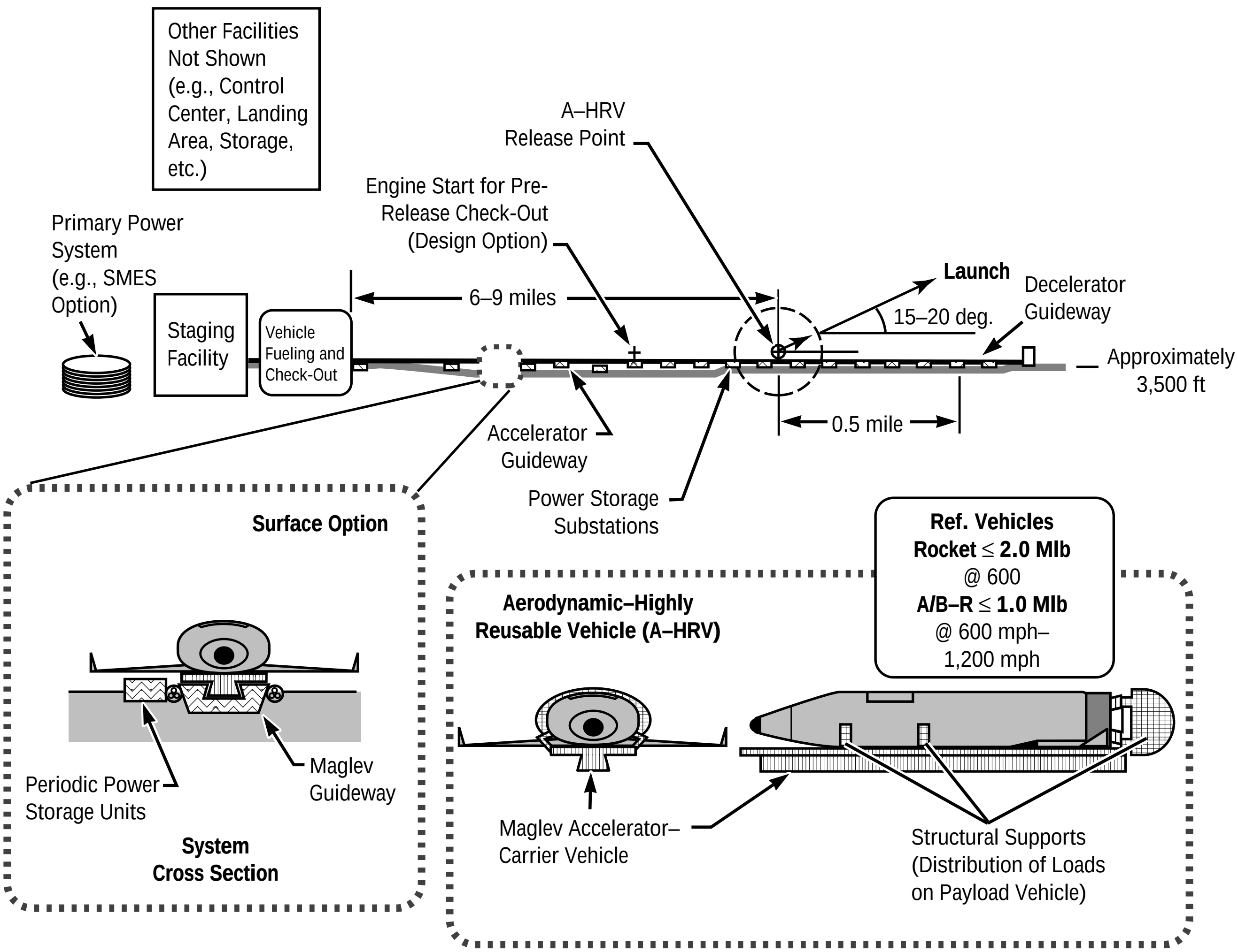

FIGURE 6.—MagLifter Space Launch System (configuration “k”); notional, full-scale system concept. This version of MagLifter is configured for a highly reusable vehicle that *does* involve the use of aerodynamic lift during launch *and runs horizontally*—0-degree inclination—at release of HRV